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Implementing Embedded Training (ET): Volume 1 of 10: Overview

Manned Systems Group
Systems Research Laboratory

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This report is an overview of nine volumes of guidelines and procedures on how to do embedded training (ET) in the Army. The contents of these volumes, their relationships to system acquisition models, the users per volume, and the products to which they contribute are briefly described. The document also contains discussions of what constitutes ET; the benefits and capabilities it can provide; some advice on the circumstances to create and the circumstances to avoid to increase the likelihood of a successful ET development; and descriptions of additional resources with points of contact for obtaining them. The additional resources include a video tape, an electronic bulletin board, and considerable documentation.

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Human Performance Effectiveness and Simulation

This document is Volume 1 of a series produced by the Army Research Institute for the Behavioral and Social Sciences (ARI) and the Project Manager for Training Devices (PM TRADE). The series consists of 10 related documents that present guidance for combat and training systems developers, including Army Materiel Command (AMC) laboratories, Training and Doctrine Command (TRADOC) Combat Developers and Training Developers, and contractor organizations involved in system development or technological thrust areas under independent research and development (IR&D) programs.

This series of documents includes guidelines and procedures that support the effective consideration, definition, development, and integration of embedded training (ET) capabilities for existing and developmental systems. The 10 documents share the general title of Implementing Embedded Training (ET), with specific, descriptive subtitles for each document. They are as follows:

1. Volume 1. Overview presents an overall view of the guidance documents and their contents, purposes, and applications, including a discussion of these factors:

   a. the total training system concept, including embedded training;

   b. how training systems must develop within more general processes of materiel system development;

   c. how embedded training must affect this relationship; and

   d. the content and uses of the remaining documents in the series, their relationships to the training systems development and acquisition processes, and how to use them.

2. Volume 2: ET as a System Alternative provides guidelines for the initial decision as to whether ET should be further considered as an alternative training system for a given materiel system. It also includes guidance on considering ET as an alternative for systems under product improvement or modification, after fielding.

3. Volume 3: The Role of ET in the Training System Concept contains guidance for the early estimation of training system requirements and the potential allocation of such requirements to ET.

4. Volume 4: Identifying ET Requirements presents procedures for defining ET requirements (ETRs) at both initial levels (i.e., before initiating system development) and for revising and updating initial ETRs during system design and development.

5. Volume 5: Designing the ET Component contains analytic procedures and guidance for designing an ET component concept for a materiel system, based on specified ETRs.

6. Volume 6: Integrating ET with the Prime System contains considerations, guidance, and "lessons learned" about factors that influence the effective integration of ET into materiel systems.

7. Volume 7: ET Test and Evaluation presents guidance for defining the aspects of the ET component (test issues) to be addressed in prototype and full-scale system testing.

8. Volume 8: Incorporating ET into Unit Training provides guidance for integrating ET considerations and information into unit training documentation and practice.

9. Volume 9: Logistics Implications presents guidance on key logistics issues that should be addressed in the context of ET integration with prime item systems.

10. Volume 10: Integrating ET into Acquisition Documentation provides guidance on developing the necessary documentation for, and specification of, an ET component of a prime item during the Army's systems development and acquisition process. This document discusses the Life Cycle System Management Model (LCSMM) and the Army Streamlined Acquisition Process (ASAP) and describes where and how to include ET considerations in the associated documentation. It also describes how to use the other volumes in the ET Guidelines series to generate the information required for the acquisition documentation and provides guidance in preparing a contract Statement of Work for an ET component to a prime item system.

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Technical Director

IMPLEMENTING EMBEDDED TRAINING (ET):
VOLUME 1 OF 10: OVERVIEW

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IMPLEMENTING EMBEDDED TRAINING (ET): VOLUME 1 OF 10: OVERVIEW

INTRODUCTION

This overview provides background information and a description of nine "how to do" volumes available to support the selection, development, and fielding of embedded training (ET) as a part of the training system developed to support a materiel system.[1] The potential utility of ET to the Army cannot be realized unless the necessary development process is properly executed. These documents provide the information needed by the training developer, combat developer, materiel developer, logistician, and tester to effectively exercise that process and ensure that the engineers understand what is required and deliver accordingly. However, except for Volume 6 to some limited extent, these documents do not tell the engineer how to do his job. That awaits further work.

The major documents described here present procedures and guidelines for performing the ET development process within the Army systems development and acquisition process, sometimes called the Life Cycle Systems Management Model (LCSMM, as described in DA Pamphlet 11-25). These procedures and guidelines also apply to acquisition of Army systems within the Army Streamlined Acquisition Process (ASAP), Non Development Item (NDI) procurements, Pre Programmed Product Improvements (P^3I), and Product Improvement Programs (PIPs) as well. Available supporting documents are identified that will provide background information and examples of products resulting from development and evaluation studies. Also identified are points of contact who can provide access information on these documents, an introductory video tape, and an electronic bulletin board.

The development of this series of ten volumes has been based on knowledge gained from these activities: (1) Survey of ET components in Army, Navy, and Air Force systems to identify what kinds of ET have been implemented under what circumstances and

[1] This volume was initially distributed under the title, "How to Select and Develop Embedded Training: Overview of Interim Guidelines, Procedures, and Supporting Documentation", and subsequently under the title, "Implementing Embedded Training (ET): Volume 1 of 10: Interim Overview." This is a revised and expanded version of those documents.

which were successful and why; (2) Survey of selected Army systems to identify the extent and nature of the potential for ET development and implementation in the Army; (3) Survey of current and projected technological capabilities for supporting ET implementations in systems; and (4) ET development or evaluation activities on Fiber Optic Guided Missile, Sergeant York, Howitzer Improvement Program, Armored Family of Vehicles, Upper Echelon Maneuver Control System 2, and All Source Analysis System. The ten volumes are considered by the Army to be interim documents based on what we know from our experiences to date. It is anticipated that revisions to these volumes will become appropriate as the Army gains additional experience in developing and fielding ET.

BACKGROUND

Before describing the contents and uses of the nine "how to do ET" volumes the following are presented as background information: (1) A definition of ET; (2) Listing of some capabilities and benefits that ET can provide; and (3) Three admonitions to be held in mind when considering ET.

A Definition of ET: ET is defined by the authors as that training which results from feature(s) incorporated into the end item equipment to provide training and practice using that end item equipment. The features may be completely embedded within the system configuration by software application or a combination of both software and systems configuration; or may be executed by some form of strap on (e.g., a video disc player) or plug in (e.g., a floppy disc) equipment: or a combination of embedded and appended components. The feature(s) MUST include stimuli necessary to support training: they SHOULD include: performance assessment capability, appropriate feedback, and record keeping. See Appendix A for the definition provided by Army policy and Appendix B for brief discussions of the forms ET can take and varieties of capability that ET can provide.

Some Capabilities and Benefits that ET Can Provide: Army policy (see Appendix A) dictates that ET be the first alternative reviewed for providing training in these categories: individual operator or maintainer, crew, functional area, and force level. ET has the advantages of unit accessibility and equipment fidelity. Training devices, however, may be selected instead of or in addition to ET due to having greater simulation capabilities or the conveniences of a special training environment. The benefits that ET can provide are many. They include: (1) A training capability that is concurrent with fielding and will support mobilization. (2) Refresher and sustainment training capability resident in the unit. An entry level training capability for MOS-qualified personnel and other

types of training also can be provided if the design of the end item equipment will permit it and a policy decision is made to require it. The design of the ET must accommodate state of readiness (SOR) considerations and can usually do so very well. (3) Relieve the unit training management burden. To the extent that the ET is designed to provide an assessment capability which is easily accessible by unit training management personnel and does not require onsite trainers and evaluators, unit training managers will better know and execute the state of training, and be able to program accordingly, with a minimum investment. (4) Minimal logistics impacts for the end item equipment.[2] (5) Training that is standardized across units. (6) Training that may be more cost effective in meeting essential training requirements and that cannot otherwise be provided within cost or safety constraints. (7) Better job aids (e.g., "help" functions) for the system user. The process for designing tutorials and trainee feedback in support of computer aided instruction (CAI) and simulation exercises, and the resulting products provide the basis for not only effective ET but also job performance aids.

Three Admonitions: First, ET should always be viewed as a capability of an operational system within the context of the overall training system supporting the materiel system. I.e., ET itself will always exist as a component of the overall training system rather than being the total training system itself (whether used in the unit or the institution). It should be conceived of, designed, and used accordingly. Second, consideration of the ET option must begin early in the system development cycle. In order to realize the most effective accommodation of maximum ET capabilities within the constraints of the prime system design, one must follow the dictum, "earlier is better." The initial question, "Does ET appear to be a viable option for this system?" should first be addressed during the Mission Area Analysis (MAA) phase of requirement development programs. Third, in line with the second admonition, not only must work begin early on ET, the training developer must be involved - from the beginning of and for the duration of the acquisition process.

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[2] Obviously, ET often imposes some logistics impacts of its own (e.g., wear and tear on generators). To what extent, depends on how it is designed and the conditions under which it is used. It is also possible, however, that ET may reduce some of the logistics burden imposed by the operational system itself. This is because previous studies have determined that 5% to 65%, with a mode of 13%, of system maintenance actions result from operator and maintainer performance errors; better unit training through ET should reduce these error levels (Meister, Sullivan & Finley, 1970; Meister, Finley & Sullivan, 1970; Barneby, Meister & Finley, 1972).

DESCRIPTION OF THE ET GUIDELINES AND PROCEDURES, AND THEIR USE

The LCSMM was reviewed to determine "what had to be done (and where)" to support the development of an ET component. The review of the LCSMM started with the MAA and extended through to the product improvement of a fielded system. The realities and varieties of government and contractor responsibilities and interaction were considered. A total of nine system development activities requiring "how to do" documentation were identified and, hence, our nine volumes. Nineteen categories of players were identified; we are certain that others remain to be identified. The roles of the players ranged from those who simply must be aware of system ET events to those who do the determining analyses to those who have sign-off authority.

Table 1 lists the ten volumes constituting the ET guidelines and procedures: nine "how to do" documents, plus this overview document, with a brief description of each. More detailed descriptions are provided below. Figure 1 presents flow diagrams for the LCSMM and the ASAP and identifies which guidelines and procedures documents support which blocks of activity in each. Volumes 2 through 5 are used sequentially and support the development of ET beginning with, and in conjunction with, the conceptualization and subsequent development of the materiel system. Figure 1 identifies the iterative use of these and the other guideline and procedures volumes throughout the development process. If any of the materiel system development phases are iterated due to needs to change or further develop system capabilities and design then, of course, ET efforts may need to be iterated also (as in Proof of Principle or Development and Production Proveout phases). Figure 2 lists the nineteen categories of anticipated users of the ET documents and which documents they are most likely to use. This figure is intended only to suggest, not to establish or define, any agency responsibilities. Table 2 identifies, per user, the products they produce and the probable set of guideline documents supporting the development of those products.[3]

Below are brief descriptions of the guidelines and procedures documents, as appropriate for an overview document, and reference information. For more detailed descriptions of the inputs required and the outputs resulting from each of the nine volumes see: the volumes themselves; Volume 10; and the ET Development and Evaluation Studies, listed on pages 16 - 17.

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3 The reader is referred to Volume 10 of this series for a more definitive treatment of the contribution of each volume to specific products that must be produced (e.g., STRAP, ILSP, SOW).

Table 1. Embedded Training Guidelines and Procedures Documents

TITLE	DESCRIPTION
1. OVERVIEW	1. OVERVIEW OF ET, THE ENTIRE PRODUCT SET, AND HOW AND WHEN TO USE WHAT
2. ET AS A SYSTEM ALTERNATIVE	2. GUIDELINES FOR MAKING A DECISION ABOUT WHETHER OR NOT TO FURTHER CONTINUE CONSIDERATION OF ET
3. ROLE OF ET IN THE TRAINING SYSTEM CONCEPT	3. GUIDELINES FOR MAKING AN EARLY ESTIMATION OF TRAINING SYSTEM REQUIREMENTS AND DETERMINING THE POTENTIAL ALLOCATION TO ET
4. IDENTIFYING THE ETR	4. PROCEDURES FOR ITERATIVELY DETERMINING THE ETR AS INFORMATION BECOMES PROGRESSIVELY AVAILABLE AND DETAILED
5. DESIGNING THE ET	5. PROCEDURES FOR ITERATIVELY DEVELOPING THE INSTRUCTIONAL, SOFTWARE, AND HARDWARE DESIGN OF THE ET AS THE SYSTEM DESIGN ENVOLVES
6. INTEGRATING ET WITH THE SYSTEM	6. GUIDELINES FOR INTEGRATING ET INTO THE DESIGN OF THE SYSTEM ITSELF INCLUDING BOTH SYSTEM SOFTWARE AND HARDWARE DESIGN
7. ET TEST AND EVALUATION	7. GUIDANCE FOR PREPARATION OF TEST ISSUES FOR THE TEMP AND CONDUCT OF IN-PLANT TESTS AND TT/UT
8. INCORPORATING ET INTO ARMY UNIT TRAINING	8. GUIDANCE FOR DEVELOPING THE USER DOCUMENTATION PROVIDED TO UNIT PERSONNEL; AND TO UNIT PERSONNEL ON ET USE
9. LOGISTICS IMPLICATIONS	9. GUIDANCE TO ASSIST THE DEFINITION OF THE SUPPORT REQUIREMENTS IMPOSED ON THE SYSTEM BY INCLUSION OF ET
10. INTEGRATING ET INTO ACQUISITION DOCUMENTATION	10. GUIDELINES ON WHICH OF THE ABOVE VOLUMES TO USE IN PREPARATION OF SPECIFIC ACQUISITION DOCUMENTS. DETAILED GUIDANCE ON HOW TO PREPARE PROCUREMENT DOCUMENTATION WITH GENERIC MODELS OF AN SOW AND ET SPECIFICATION.

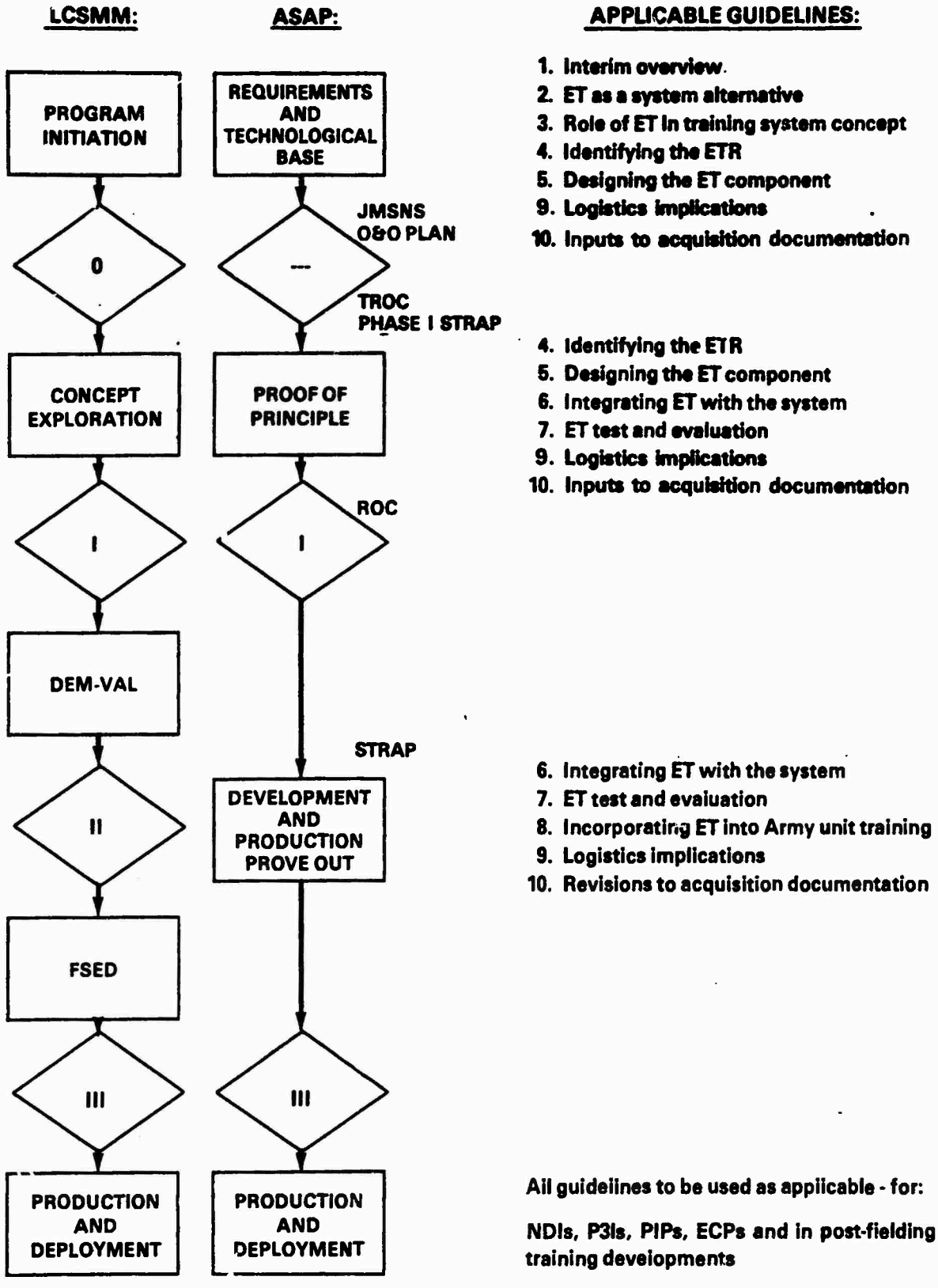

Figure 1. System Acquisition Processes and the Application of ET Guidelines and Procedures

USERS	PRELIMINARY PROCEDURES AND GUIDELINES PRODUCTS								
	2 ET SYST. ALT.	3 EST'G ET ROLE	4 IDENT ETR	5 DES. ET COMP.	6 INTEG. ET w/ SYST.	7 ET TEST, EVAL.	8 INCOR. ET w/ UNIT	9 ET LOGS IMPL.	10 ACQ'N DOCS.
OTEA/BOARDS						M,I			
TRADOC	M		X	M/X	M	X	X	M/X	
DCST/DCSCD	I/X/M		I/M	I/M	M	I,M		M	
TRADOC-STD	A	A	A					A	
SCHOOL CDs	D/M	D/M	D/M	D/M		D/M	I	D	M
SCHOOL DOTDs	I	I/D/M	I/D/M	I/M	I/M	I/D/M	I/M		M
SUPPORT CONTRACTORS	D	D	D	I		D		I	I
INTEGRATING CENTERS e.g., CAC	M	M	M	M	M	M	M	M	M
TSMs	M	M	M	M	M	M	M	M	M
ATSC	I	A	I	I			M/X	I	
PRIME CONTRACTORS	I	D	D	D	D	D	D	I/D	D
AMC-HQ			X	M/X	M/X				
PM TRADE	M/A	D/M	D/M/A	D/M/A	M		M	M	D/M
SUPPORT CONTRACTORS	I/D	D	D	D			D	I/D	D/M
AMC LABORATORIES	D/I	D	D	D	D	D		D	
PMs	M	D/M	M	M/X	M/X	M/X	M/X	M/X	M/X
LOGISTICS AGENCIES	A	A	A	A	A			M,X	M
SPEC. STUDY GROUP	D	D	D	D				D	M
ASARC/DSARC				X	X	X		X	

LEGEND:
- D-DO THE PROCESS
- M-MONITOR THE PROCESS
- A-BE AWARE OF THE RESULTS
- X-APPROVAL AUTHORITY FOR RESULTS
- I-INPUT TO THE PROCESS

Figure 2. Users Of Preliminary ET Guidelines and Procedures Products

Table 2. User's Products Affected by Specific ET Guidelines and Procedures Volumes

User:	ET Volume Used:	User Product Affected:
OTEA, Boards, TEXCOM	Volume 7	TT and UT test design and conduct, TTSP, IEP
TRADOC DCST, DCSCD	All volumes	Monitor, review, and approval processes for training developments
TRADOC STD, ATSC	All volumes	Increased capability for monitoring training system development
School DCDs and DOTDs	All volumes	MAA; MADP; BDP; MA deficiency solutions-materiel solution and training solutions; O&O Plan; JMSNS; ROC; MANPRINT SMMP; TEMP; CMF, MOS decisions and initial manning; training requirements (including ETRs); STRAP; selected SMs, FMs, and other ITEP and ARTEP materials
TSMs	All volumes	Increased capability for monitoring training system development
Contractors	All volumes	IR&D; System Concept Formulation Package; system operating procedures and personnel task requirements; training system design; training package design and implementation in specific training programs
PM TRADE and Contractors	All volumes	Concept Formulation Packages; BTA; RFPs; SOWs; improved monitoring of training systems, TD and ET developments

Table 2. User's Products Affected by Specific ET Guidelines and Procedures Volumes (Continued)

User:	ET Volume Used:	User Product Affected:
AMC Laboratories	Volumes 1-7, 9	In in-house technology thrust developments, and in accelerated developments: Products affected are similar to TRADOC CD and TD staffs, and of the prime contractor in conventional system development
Program Managers	All volumes	RFPs; SOWs; improved capability for monitoring contractor development of system and training system
Logistics Agencies	Volumes 1-6, 9	Specification, provision, and monitoring of system and ET logistics needs
Special Study Groups	Volumes 1-5, 9	When constituted, performs in lieu of or in coordination with School CDs and TDs. Will affect needs statements, O&O Plan, ROC and other documents
ASARC, DSARC	Volumes 5, 6, 7 and possibly others	Volumes will work to provide inputs necessary to ASARC and DSARC decisions as required, by milestone

Guidelines for the Initial System Decision about Further ET Consideration

This document presents guidelines for making the initial decision at the system level about whether to include ET in the system design. A decision to include ET, or at least to continue to consider ET, should be reached and expressed in the MAA, Mission Area Development Plan (MADP), Battlefield Development Plan (BDP), Operational and Organizational (O&O) Plan, and Justification for Major System New Start (JMSNS) documents. The requirement to monitor its progress and address any issues then should become part of the Systems MANPRINT Management Plan (SMMP). This guideline volume also incorporates guidance on how to make the initial decision on whether or not to develop ET component(s) when systems undergo major corrections or are iteratively developed (e.g., PIP, P3I). This document has applicability at subsequent stages when a decision needs to be made about the reasonableness of ET for a specific segment of operator or maintainer performance. Reference: Strasel, H.C., Dyer, F.N., Roth, J.T., Alderman, I.N. and Finley, D.L. Implementing Embedded Training (ET): Volume 2 of 10: ET as a System Alternative. ARI Research Product, Draft, November 1987.

Guidelines for Early Estimation of Training System Requirements and Potential Allocation to ET

This document provides the means for providing hands on training strategy and ET role concepts to the SMMP, JMSNS, O&O Plan, and the ROC, especially when functional behavioral requirements for operator and maintainer roles and functions have been generally defined but the specific tasks have not. This volume can aid the specification of alternatives to be evaluated as in Cost and Operational Effectiveness Analysis (COEA), Cost and Training Effectiveness Analysis (CTEA), and other front end analyses. ET issues that will require further analysis should be inserted into the training portion of the SMMP to ensure their full consideration (e.g., in a CTEA). Reference: Roth, J.T. Implementing Embedded Training (ET): Volume 3 of 10: The Role of ET in the Training System Concept. ARI Research Product, Draft, November 1987.

Introduction to Guidelines and Procedures Volumes 4 and 5 for Identifying ET Requirements and Determining the Design Concept

Procedures are provided in these two volumes for definition of the requirements for ET and then for translating the ET requirements into ET design concepts. This paragraph provides an overview; specifics regarding the volumes are in the next two

paragraphs. The definition of ET requirements is based on descriptions and analyses of operator and maintainer functions and tasks. It is an employment of the basic trainer's axiom: in order to train a solder to do his or her job, one must know what the soldier's job is. To the extent Logistics Support Analysis (LSA) and ECA, HARDMAN or another similar analytical technique have been done as a part of MANPRINT, a partial data base will exist. To the extent the Instructional System Development (ISD) or Systems Approach to Training (SAT) process has been started, the ET requirements analyses and design concept development will be a minor extension. Translating the ET requirements into design concepts will result in (1) design of the training modules and content, and (2) identification of ET specific software and hardware components, and the interfacing of these with the operational system. To the extent feasible, both documents provide guidance for dealing with lesser and greater levels of task definition; it is assumed that these procedures will be iteratively applied as a part of or in conjunction with the iterative ISD or SAT process, with transition within and between documents 3 and 4 as appropriate, given increasing availability of information. They provide the procedures for dealing with creation of inputs to the O&O Plan, ROC, Systems Training Plan (STRAP), procurement documents, and other documents.

How to Determine the Needs for ET

These procedures will be used to determine the requirements for an ET capability. It must be understood that these requirements can be met by other means, e.g., training devices, either exclusively or jointly. Consideration of these trade off questions are dealt with primarily in the preceeding document, Volume 3. This document, Volume 4, provides the procedures for determining more precisely which tasks of the total job particularly need sustainment training. Given there are needs, then the question of entry level, cross, and refresher training requirements can be addressed. Reference: Roth, J.T. Implemementing Embedded Training (ET): Volume 4 of 10: Identifying ET Requirements-Revised. ARI Research Product, Draft, November 1987.

How to Develop the ET Design Concept

These procedures will be used in conjunction with the LSA process to configure the instructional design of the ET package and to conceptualize the nature of the interface with the operational system hardware and software. Reference: Roth, J.T., Fitzpatrick, J.A., Warm, R.E. and Ditzian, J.L. Implementing Embedded Training (ET): Volume 5 of 10: Designing the ET Component-Revised. ARI Research Product, Draft, December 1987.

Procedures and Guidelines for Integrating the ET Design Concept into the Initial and Final System Design

ET developers must remain closely involved in the materiel system development process throughout system development. The foregoing documents dealt with establishing the ideals with some knowledge of feasibilities. The realization of anything very near the ideal requires close coordination with the LSA program and continuing tradeoffs to establish priorities, taking continuing actions to ensure that the requirements are being met, and, for example, making sure that the system hardware and software designers do not exclude or limit ET capabilities unnecessarily. What we have learned thus far from hard experience will be in this document. There is, undoubtedly, much more to learn. Reference: Cherry, W.P. and Evans, S.M. Implementing Embedded Training (ET): Volume 6 of 10: Integrating ET with the Prime System. ARI Research Product, Draft, April 1988.

Guidance for Defining ET Test Issues and Test Conduct

What is known and recommendations on how to proceed are presented in this document. For example, inplant testing prior to operational test of the materiel system is seen as especially appropriate for ET. Recommendations for same are based on experience and current Army test policies. Guidance is given for preparation of ET issues to be included in the Test and Evaluation Management Plan (TEMP). Reference: Purifoy, G.R., Jr. and Ditzian, J.L. Implementing Embedded Training (ET): Volume 7 of 10: ET Test and Evaluation. ARI Research Product, Draft, March 1988.

Guide to Integrating ET into the Unit Training Process

This document provides guidance to developers responsible for creating documentation, e.g., users manuals, instructor guides, etc., to support utilization of the ET component by unit personnel. Reference: Aldrich, R.E., Strasel, H.C. and Strasel, B.D. Implementing Embedded Training (ET): Volume 8 of 10: Incorporating ET into Unit Training. ARI Research Product, Draft, November 1987.

Guidance to Definition of Logistical Support Requirements of System Imposed by Inclusion of ET

This guideline defines the ways in which training developers and logisticians must interface, in terms of what questions the

logisticians must ask and what kinds of answers the training developers must provide. The two categories of interaction include determination of equipment usage factors resulting from anticipated use of the ET component, and development of post deployment logistical and training development support capabilities. Reference: Cherry, W.P. and Purifoy, G.R., Jr. Implementing Embedded Training (ET): Volume 9 of 10: Logistics Implications. ARI Research Product, Draft, March 1988.

Integrating ET into Acquisition Documentation

Detailed guidance is provided for developing inputs regarding ET into the government acquisition documentation from the MAA to the Integrated Logistics Support Plan(ILSP) to the Request for Proposal (RFP) and Statement of Work (SOW). A generic model and example inputs are provided for procurement documentation, including that appropriate for the SOWs, Data Item Descriptions (DIDs), and specifications for the ET component. Reference: Carroll, R.J., Evans, D.C., Ditzian, J.L. and Roth, J.T. Implementing Embedded Training (ET): Volume 10 of 10: Integrating ET into Acquisition Documentation. ARI Research Product, Draft, December 1987.

AVAILABLE VIDEO TAPE, ELECTRONIC BULLETIN BOARD AND ET DOCUMENTATION

A twenty minute high quality video tape is available in either VHS or U-matic format which provides an introduction to the concept of embedded training and to the above described guidelines and procedures volumes. If you are interested, contact the USARI or PM TRADE points of contact (POCs) presented below.

We are also establishing an electronic bulletin board for interested persons who would like to leave or read messages, and ask questions, about what is going on in the ET arena. It will be accessible by calling through your computer or terminal (and modem). If you are within the metropolitan Washington, D.C. area you will be able to use a local phone number. If you are outside of the Washington area, the ET bulletin board will be accessible by calling an 800 number through your computer or terminal. This bulletin board will provide the means of asking questions, which will be answered by ARI or PM TRADE within 36 hours, or providing information regarding your experiences with ET to other users. When you establish connection with the bulletin board, you will be asked your username and your password. The username is ETBB (for Embedded Training bulletin board); the password is ARIETBB. The ET bulletin board will then ask you to register for the bulletin board users list. This list

will allow the moderators at ARI and PM TRADE to contact users directly to answer questions or to send materials that are not easily put on the bulletin board. Registering involves giving your full name (last name first), affiliation, position, mailing address, phone numbers (commercial and autovon), and DDN username and host computer if you are on the DDN network. Once you have registered you will be given a three character alpha numeric code (e.g., EFO). The next time you log onto the ET bulletin board you can use this code and the system will recognize that you have already registered for the bulletin board. You will then be taken through the instructions for using the ET bulletin board. You will be shown how to select the folder in which you are interested, how to read and add messages, and how to exit the bulletin board. If you need assistance on using the bulletin board at any time while you are in it, type HELP (or just H) at the prompt. This will give you the entire set of help modules for the ET bulletin board. This includes instructions and the quick reference for many of the functions. You can go to the instructions by typing INSTRUCTIONS (or I) at the prompt and you can see the Brief reference by typing BRIEF (or BR) at the prompt. The quick reference is what you will see each time you log onto the bulletin board after the first time. If you have a question that you need to ask someone directly you may phone the POCs given below.

In addition to the nine "how to do ET" volumes there is available other documentation which has resulted from the ARI and PM TRADE program of research on ET. This documentation is presented below under these categories: surveys, ET development and evaluation studies, exemplar ET acquisition documents, and other. Each document is preceeded by an identifier to facilitate search, followed by the specific reference. Requests for copies of the above described video tape, or for the nine volumes described above and reports listed below should, for the near term, be addressed to either:

USARI
ATTN: PERI-SM (Dr. Alderman)
5001 Eisenhower Avenue
Alexandria, VA 22333

Ph: (202) 274-9134
AV 284-9134

PM TRADE
ATTN: AMCPM-TND-ET (Mr.Peckham)
NTC-Orlando, FLA 32813-7100

Ph: (305) 646-5881/5771
AV 791-5881/5771

These documents will gradually become available through NTIS and DTIC.

Surveys

Army Systems Survey. Strasel, H.C., Dyer, F.N., Aldrich, R.E. and Burroughs, S.L. (1986). Review of eight army systems: characteristics and implications for embedded training. ARI Technical Report.

Tri-Service Survey. Warm, R.E., Roth, J.T., Sullivan, G.K. and Bogner, M.S. (1987). Tri-service review of existing system embedded training (ET) components. ARI Research Note.

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All Source Analysis System/Enemy Situation Correlation Element (ASAS/ENSCE).

ET Design Concept: Evans, D., Adams, J.E., Simkins, M.L., Fitzpatrick, J.A., Hattrup, R., Aldrich, R.A., Dyer, F.N. and Narva, M.A. (1988). Preliminary embedded training design and integration concepts for ASAS/ENSCE (U). ARI Research Product. SECRET.

ASAS Task Analyses for ET: Evans, D., Adams, J.E., Simkins, M.L., Fitzpatrick, J.A., Aldrich, R.A., Dyer, F.N. and Narva, M.A. (1988). Preliminary embedded training design data for ASAS/ENSCE (U). ARI Working Paper. SECRET.

Armored Family of Vehicles (AFV).

Training System Concept: Applied Science Associates, Inc., Vector Research, Inc. and Hi-tech Systems, Inc. (1987). Training systems concepts for the Armored Family of Vehicles with consideration of the roles of embedded training and stand-alone training devices. ARI Research Product.

Forward Area Air Defense Non Line of Sight (FAAD NLOS).

ET System Specification: Farmer, J., Rueter, H. and Evans, S. (1987). FOG-M embedded training (ET) system specification: Volumes 1 through 6. ARI Working Paper.

ET Demonstration Courseware: Simpkins, M.L., Beilstein, Jr., K.R. and Hattrup, R.A. (1988). FOG-M Demonstration Courseware: Lessons 1-4. ARI Working Paper.

Fiber Optic Guided Missile (FOG-M).

Requirements for ET: Purifoy, G.R., Jr., Chenzoff, A.P., Harris, C.B., Roth, J.T. and Strasel, H.C. (1985). FOG-M system task and training requirements analysis for embedded training (ET). ARI Research Product.

ET Design Concept: Purifoy, G.R., Jr., Harris, C.B., Ditzian, J.L., Meerschaert, M. and Wheaton, K.L. (1985). Design concepts for FOG-M system embedded training (ET). ARI Working Paper.

ET Courseware Outlines: Ditzian, J.L., Adams, J.E. and Sullivan, G.K. (1986). FOG-M system embedded training (ET) demonstration courseware outlines. ARI Working Paper.

Howitzer Improvement Program (HIP).

ET Requirements and Design Concept: Ditzian, J.L., Sullivan, G.K., Adams, J.E. and Bogner, M.S. (1986). Embedded training (ET) and training devices for the Howitzer Improvement Program (HIP): Volume 1: Design concept recommendations. ARI Research Product.

Task Descriptions and Analyses: Ditzian, J.L., Sullivan, G.K., Adams, J.E. and Bogner, M.S. (1986). Embedded training (ET) and training devices for the Howitzer Improvement Program (HIP): Volume 2: Appendices. ARI Research Product.

ET Unit Utilization Plan: Ditzian, J.L. Unit training resourses utilization concept (UTRUC) for new training devices for the Howitzer Improvement Program (HIP). (1986). ARI Working Paper.

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ET Acquisition Documents

Draft ET Functional Specification and Data Item Descriptions (DIDs). Carroll, R.J., Harris, C.B. and Roth, J.T. (1986). Draft functional specification and data item descriptions for FOG-M embedded training subsystem. ARI Research Product.

B5 Specification. Meerschaert, M., Rainaldi, W., Smith, R., Thompson, D., Frederick, C. and Wheaton, K. (1986). Embedded training software specifications for the FOG-M system demonstration. ARI Research Product.

SOW Requirements Document. a draft is available but is procurement sensitive. Contact the POCs listed above if considered critical to your needs: Fitzpatrick, J.A., Adams, J.E., Evans, D.C. and Aldrich, R. (1986). Review of the embedded training requirements documentation for ASAS/ENSCE. ARI Working Paper.

RFP, SOW and Evaluation Criteria Inputs. This may also become procurement sensitive. Contact the POCs above regarding your needs. Carroll, R.J. Purifoy, G.R., Jr. and Cherry, W.P. (1988). RFP and SOW preparation guidance and proposal evaluation criteria for the embedded training component of the Armored Family of Vechicles. ARI Working Paper.

Other

Army R&D Magazine: Finley, D.L., Alderman, I.N., Bolin, S.F. and Peckham, D.S. Embedded training and systems acquisition. Army R&D Magazine, May-June 1985, Vol 26(3), 20-22.

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Contract Annual Report: Roth, J.T. (1986). Systems design concepts to support embedded training (ET): First annual report. ARI Research Note.

PROCEDURES FOR MAKING COMMENTS AND SUGGESTIONS

Again, as noted in the introductory remarks, the ten guidelines and procedures volumes, including this one, are considered to be interim documents at this time. The US Army Research Institute and Project Manager for Training Devices would appreciate any comments that might lead to their improvement. We ask that you provide feedback and comments to us. Please contact the above identifed personnel through either written or telephonic means.

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APPENDIX A

ARMY EMBEDDED TRAINING POLICY

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

3 March 1987

SUBJECT: Embedded Training

SEE DISTRIBUTION

1. Purpose: To provide guidance and establish policy for embedded training. An embedded training capability will be thoroughly evaluated and considered as the preferred alternative among other approaches to the incorporation of training sub-systems in the development and follow on Product Improvement Programs of all Army materiel systems.

2. The requirement to train in peace and war continues to exist. Soldiers and units that deploy to combat with equipment that contain an embedded training capability will possess the tools necessary to sustain proficiency in conjunction with combat operations. Further, peacetime constraints on individual and collective training caused by time, space and resource shortfalls are expected to continue.

3. Embedded training is defined as training that is provided by capabilities designed to be built into or added into operational systems to enhance and maintain the skill proficiency necessary to operate and maintain that equipment end item. Embedded training:

a. Will not adversely impact the operational requirements/capabilities of the system and should be identified early enough to be incorporated into initial prototype designs.

b. May train individual tasks through force-level collective tasks as required.

4. Embedded trainers encompass four training categories:

a. Category A-INDIVIDUAL/OPERATOR.

Training Objective: To attain and sustain individual, maintenance, and system orientation skills.

b. Category B-CREW.

Training Objective: To sustain combat ready crews/teams. This category builds on skills acquired from Category A.

c. Category C-FUNCTIONAL.

Training Objective: To train or sustain commanders, staffs, and crews/teams within each functional area to be utilized in their operational role.

d. Category D-FORCE LEVEL (Combined Arms Command and Battle Staff)

Training Objective: To train or sustain combat ready commanders and battle staffs utilizing the operational system in its combat operational role.

5. Requirements and resources for training must be factored by the systems proponent in concept formulation of the end item/system and pursued throughout the materiel acquisition process. A training strategy, to include the consideration of embedded training, must be included in the initial requirements documents (Operational and Organizational Plan).

6. Integrated Logistic Support (ILS) and MANPRINT are the catalysts for factoring embedded training during the Pre-Concept Exploration and Prototyping Phase of the Life Cycle System Management Model (LCSMM). Embedded training will be addressed at all Materiel Decision Process Reviews and at each milestone for all system acquisition programs through the ILS plan and Systems MANPRINT Management Plan. During the reviews, system proponents will provide a definitive training strategy with associated analysis and rationale supporting use/non-use of embedded training.

7. Proponents of materiel acquisition process publications and training device publications will review all documents and publish interim changes in accordance with milestones at enclosure. Implementation of this policy will require the concentrated efforts of many diverse agencies of HQDA and MACOM's. ODCSOPS is designated lead agent for this initiative. The enclosed milestones provide a road map for institutionalizing embedded training as a primary consideration for fielding in all future operational Army systems.

M. R. THURMAN
General, United States Army
Vice Chief of Staff

James R. Ambrose
Under Secretary of the Army

Enclosure

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EMBEDDED TRAINING - MILESTONES

Action	Lead	Date
DEVELOP AND PUBLISH IMPLEMENTING INSTRUCTIONS AND ACTION PLANS TO: O ESTABLISH EMBEDDED TRAINING AS PREFERRED TRAINING SYSTEM. O STRENGTHEN MATERIEL DEVELOPER/ COMBAT DEVELOPER/TRAINING DEVELOPER INTERFACES.	MACOMs	Apr 87
COMPLETE REVISION OF ARs.	DA STAFF	Jul 87
COMPLETE REVISION OF SUPPLEMENTAL REGULATIONS.	MACOMs	Sep 87
COMPLETE IDENTIFICATION AND REVISIONS OF EMERGING MATERIEL SYSTEM REQUIREMENT DOCUMENTS, TO INCLUDE EMBEDDED TRAINING CAPABILITY REQUIREMENTS FOR THOSE SYSTEMS WHICH HAVE NOT REACHED MILESTONE I OF THE MATERIEL ACQUSITION PROCESS.	MACOMs	Oct 87
CONDUCT DA EMBEDDED TRAINING IPR.	DCSOPS	Dec 87

APPENDIX B

POSSIBLE EMBEDDED TRAINING ROLES, FORMS, MODES OF OPERATION, CAPABILITIES, AND LEVELS

Embedded training is both a rather old and a brand new training technology. It is old in the sense that it has been around for some time (first occurring in the Semi Automatic Ground Environment (SAGE) system in the 1950's) and has been incorporated into some number of systems. It is brand new in two senses: (1) More and more "old" systems are now appearing in new versions incorporating advanced technologies (e.g., armored vehicles) that can now take advantage of ET to some limited extent for the first time; and (2) New high technology systems are now under development that can not only incorporate ET, but ET with all the capabilities that a trainer could wish for (e.g., All Source Analysis System/Enemy Situation Correllation Element (ASAS/ENSCE)). In considering ET as an option in a system development program, the developers need to begin with an understanding of what is possible and then to proceed to determine what is feasible in that particular end item equipment. Two words of advice: First, any ET capability, no matter how limited, may be worth the investment when consideration is given to the training requirements and to the available options to satisfy the requirement; and, second, know your training requirements and do not yield easily to any reduction in ET capability. Everyone must yield something in the system development process; but to the extent the training and combat developers, representing the user, know what they want and how to execute it, they are more likely to succeed. The provision of how to gain that knowledge is the purpose of these guidelines and procedures. The following is a distillation of findings regarding options that are available. We tried to develop the guidelines and procedures to provide approaches to reaching decisions on these options.

Possible ET Roles: ET has been traditionally thought of as a training medium for the operational unit environment and as a consideration separate from training devices, the software required to do the operational job, and the design of the soldier machine interface. There have been some number of times where that has not been the case. ET has been used in the institutional environment (e.g., TACFIRE and, possibly, ASAS/ENSCE). The development of software for ET has, in some cases, contributed to the development of software for both training devices and the operational system itself (e.g., PATRIOT and AWACS). And, especially in the Navy, ET has been originally developed as a test program for maintenance checks. Our experience with the laboratory Fiber Optic Guided Missile Test Bed (FOG-M), underscored another role that early involvement of ET considerations can play; that is, impact on the design of the

soldier machine interface (SMI). Alternative SMI and consequent system design configurations are often feasible; some are more easily and quickly trained. Early involvement of the training developer should be expected to impact on the SMI design. The fact that development of ET software can serve a number of roles and provide input to a number of other purposes does not make accounting types very happy. But it is a possible fact of life and makes cost estimation of ET perse very difficult. The cost of ET is often not nearly as large as it may first appear.

ET Forms: That which is totally and exclusively a training device and that which is totally and exclusively embedded training lie at opposite ends of a continuum. The use of Troop Proficiency Trainers for the HAWK, for example, lies somewhere between those extremes. The Army ET policy encourages consideration and development of ET that is nearer the truly embedded end of the continuum. The guidelines and procedures will support development of ET from midpoint to the ET end of the continuum. The categories of choices have been dichotomized as appended vs. truly embedded, or given a three category breakout, strap-on vs. adjunct vs. truly embedded. In any event, the choices range from the need for a separate vehicle, a la the Troop Proficiency Trainer concept; to the use of removable media, e.g., floppies or CD ROM discs or video discs; to totally integrated into the operational software system. The decision as to which way to go is dependent on what the system will easily support operationally and the resultant training capabilities vs. what is needed.

Modes of Operation: Depending on the system's O&O Plan, SOR, mission, and design, ET can be designed to operate in a number of different ways. The following are some of the options identified up to this point:

a. Off vs. On Line: Talking about continua, again, the ET component can be employed only when the system is rendered combat incapable or, at the other end of the continuum, can be in use while the operational system is in operational status. The choice depends on both what is design feasible and other considerations like security. Modern electronics and software now permit most systems to be designed such that the soldier can quite immediately transition from the training mode to the operational mode; a flip of the switch and, at most, a few seconds transition time. Other ET components have been designed to operate while the system is in a fully operational mode. The latter two cases have resulted, however, from conscious decisions and subsequent design. There are some cases where the transition time has been unacceptable due to the constraints of older technology and lack of planning.

b. Single Station vs. Networked Operations: One of the most exciting advents of advanced technology incorporations into

systems is the possibility of collective ET. This will be discussed again below. The consideration for the moment is that demanding SOR requirements may well be met if it is feasible to allow a subset of the operational asset to employ ET while other members are in an operationally ready mode. In some cases this will be feasible. Another consideration is the possibility of collective training when other crew members are absent. Again, technology, including artificial intelligence, is increasingly making this a reasonable possibility.

c. Use of the End Item Equipment: ET does require operation of the end item equipment; the question is how much and to serve what purposes. This issue relates to system hardening, LOG, and unit readiness status concerns. Usage of the end item equipment, other that of electronic and software usage, does wear out the equipment. But it must be used for training in any event and is in FTXs, etc. The need is to recognize the requirement for training, to minimize the wear and tear on the equipment to the extent possible, and to harden as necessary. One primary benefit of ET is its ability to provide training on the equipment when it is in a garrison or other standby modes resulting in much greater training availability and efficiency. This utilizes the electronic and software components, which is RAM beneficial, but also exercises the input control hardware. This hardware may have to be hardened and should be considered and planned for. Another primary benefit of ET is its ability to provide training in a more active mode (e.g., inflight) that cannot otherwise be provided at any reasonable cost whatsoever (e.g., interactive threat engagement). Here, the choice may be whether or not any reasonable amount of training is to be provided at all (e.g., F15).

Types of Training: ET has been traditionally viewed as a training medium which provides sustainment training. Further, even though it has been billed as embedded "training", in fact, in most instances, it has been embedded practice - period. Given these limited contexts, it has, nevertheless, been viewed by the unit soldiers as being very valuable. Their complaint is mainly that they wish their ET packages provided more. Again, given technology advances, ET can in many cases now offer much more. In more and more instances, ET can now offer: (1) True training; that is, ET can be designed to provide feedback, adaptivity, and performance assessment capabilities; and (2) Current systems technology is now allowing for a combination of computer aided instruction and simulation that will accomodate, not only sustainment training, but also entry level training for MOS qualified personnel, or acquisition training, and cross training. I.e., it is now possible in some cases to provide tutorials as well as skill development training. However, as always, the requirements for what ET is to provide MUST be based on what training is really needed; not just on what technology can now provide.

Levels of Training: Army ET policy requires that consideration of ET not only be directed to individual training but also to collective training, functional area or branch training, and force level training. This policy is an acknowledgement of new system designs and employment doctrines resulting from, again, advances in technology. V(INT)2, SIMNET, BMS, and Deep Battle are new examples of this. Missile Minder is an old example of this from the ET standpoint. To the extent that electronic networks are designed into systems and/or artificial intelligence can create surrogate crew member and combined arms components, ET at levels above the individual level is possible.

APPENDIX C

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

AMC	US Army Materiel Command
ARI	US Army Research Institute for the Behavioral and Social Sciences
ASARC	Army System Acquisition Review Council
ARTEP	Army Training and Evaluation Plan
ASAP	Army Streamlined Acquisition Process
ATSC	US Army Training Support Center
BDP	Battlefield Development Plan
BTA	Best Technical Approach
CAC	Combined Arms Center
CD	Combat Developer
CMF	Career Management Field
COEA	Cost and Operational Effectiveness Aralysis
CTEA	Cost and Training Effectiveness Analysis
DCSCD	Deputy Chief of Staff for Combat Development
DCST	Deputy Chief of Staff for Training
Dem-Val	Demonstration and Validation
DOTD	Directorate of Training and Doctrine
DSARC	Defense System Acquisition Review Council
DTIC	Defense Technical Information Center
ECA	A specific Early Comparability Analysis technique
ET	Embedded Training
ETR	Embedded Training Requirement
FM	Field Manual
FSED	Full Scale Engineering Development
HARDMAN	HARDware versus MANpower analyses

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

IEP	Independent Evaluation Plan
ISD	Instructional System Development
IR&D	Independent Research and Development
ITEP	Individual Training and Evaluation Plan
JMSNS	Justification for Major System New Start
LCSMM	Life Cycle System Management Model
LSA	Logistics Support Analysis
MAA	Mission Area Analysis
MADP	Mission Area Development Plan
MANPRINT	Manpower and Personnel Integration
MOS	Military Occupational Specialty
NDI	Non Development Item
NTIS	National Technical Information Service
O&O Plan	Operational and Organizational Plan
OTEA	US Army Operational Test and Evaluation Agency
P3I	Pre-Planned Product Improvement
PIP	Product Improvement Program
PM	Program Manager
PM TRADE	Project Manager Training Devices
RFP	Request for Proposal
ROC	Required Operational Capability
SAT	Systems Approach to Training
SM	Soldiers Manual
SMMP	System MANPRINT Management Plan
SOR	State of Readiness

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

SOW	Statement of Work
STD	Systems Training Directorate
STRAP	System Training Plan
TD	Training Developer Training Device
TEMP	Test and Evaluation Master Plan
TRADOC	US Army Training and Doctrine Command
TROC	Tentative Required Operaticnal Capability
TSM	TRADOC System Manager
TT	Technical Test
TTSP	TRADOC Test Support Package
USARI	US Army Research Institute for the Behavioral and Social Sciences
UT	User Test